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Dear Mike

Research in Nonlinear Water Waves
Navy Grant No. N00014-89-J-1164

Quarterly letter progress report Oct 1, 1989 - Dec 31, 1989

The work during the quarter has concentrated upon the properties and stability of capillary-gravity waves in the presence of a thin drift layer. The initial calculations of the shape of waves of permanent form were written up and submitted for publication in the Journal of Fluid Mechanics. During the course of revising the work to answer questions by referees, it was discovered that the presence of wind drift may have an important effect on the bifurcation properties and irregular wave forms of capillary gravity waves with wavelengths in the centimeter range. The wind drift layer increases the variation of wave heights in the irregular waves in which crests are not all of the same height. We are continuing with this study of waves of permanent form. Small amplitude expansions in wave height have been obtained, and work on the integral equation approach is progressing, although not as quickly as was hoped. (K)

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The investigation of stability properties of waves with thin wind drift layers also continues. The initial calculation of the spontaneous instability of capillary-gravity waves has been written up and submitted for publication in the Journal of Fluid Mechanics. Theoretical work is in progress on the effect of long swell on this instability. The formulation of the problem is not easy and progress is unfortunately not rapid, but it appears that we have reached a satisfactory formulation of the phenomena, and it is hoped that first results will be obtained early in the new year. The work on stability indicates that a thin drift layer may cause symmetry breaking in waves of permanent form, and the question arises whether this symmetry breaking may account for the observed lack of symmetry in the three-dimensional waves of permanent form observed by Su. Our previous attempts to demonstrate symmetry breaking for three-dimensional waves of permanent form in completely irrotational flow were not successful.

Work has started on an investigation of solitary gravity-capillary waves of permanent form on deep water. These were predicted this year by Longuet-Higgins, but his calculations are non-rigorous and it is well known by now that the existence of solitary waves can be a very delicate matter. An alternative formulation has been constructed which is more suitable to both analysis and numerical computation. The method seems to be working and it is hoped that we shall shortly begin to understand the nature of the phenomena. The first indications are that the waves do exist, but there are puzzling features.

With best wishes for the New Year

Yours sincerely

Philip Saffman

P.G. Saffman

cc: ONR Pasadena
cc: Director, Naval Research Laboratory
cc: Defense Technical Information Center

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